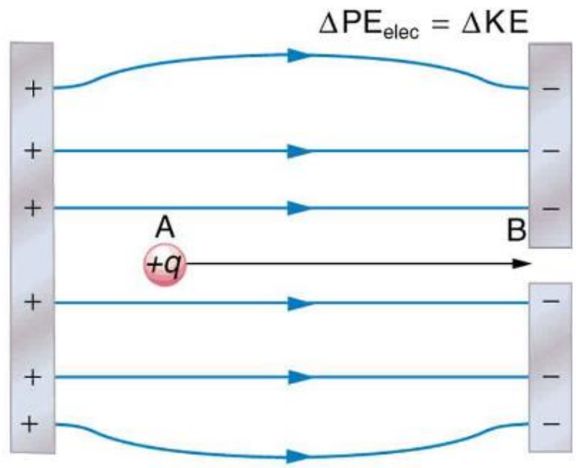
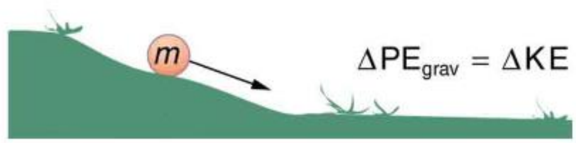
Physics 200 Name: ______________________________

Notes – 19.1 Electric Potential Energy: Potential Difference

The diagram on the right presents an analogy comparing electric potential energy to gravitational potential energy. Gravitational and Electrostatic forces are both conservative, so the law of conservation of energy applies.





1. Where in the diagram would the positive charge have the greatest potential energy?

2. If the charge (+q) were released to travel from A to B, what would happen to its potential and kinetic energy?

   PE: ____________ KE: ______________

3. *Electric Potential* is electric potential energy per unit of charge. This is not the same as electric potential energy. It is a ratio that applies to a specific point in an electric field, and it allows us to determine the potential energy of any charge at that point.

4. *Voltage = Electrical Potential Difference.* This is the difference between the electrical potentials at two different points.

5. Units and symbols:

Quantity	Symbol	Formula	Units
Electrical Potential Energy			
Electrical Potential			
Voltage (Electrical Potential Difference)			

6. In practice, you can use these formulas and units:

   ΔPE_e =

   V (voltage) =

7. Example Problem:

   Suppose you have a 12.0 V motorcycle battery that can move 5000 C of charge, and a 12.0 V car battery that can move 60,000 C of charge. How much energy does each deliver? (Assume that the numerical value of each charge is accurate to three significant figures.)

8. Electron Volts: It is useful to have an energy unit related to submicroscopic effects. An energy unit called the electron volt (eV), which is the energy given to a fundamental charge accelerated through a potential difference of ____________.

   1eV = _______________ J

Practice – 19.1 Electric Potential Energy: Potential Difference

$q_{electron} = -1.6x10^{-19}C$ KE = $\frac{1}{2}mv^2$

1. A. What is the speed of an electron starting from rest accelerated through a potential difference of 100 V? $m_e = 9.11 \times 10^{-31}$ kg

   B. What is the speed of a proton starting from rest accelerated through a potential difference of 100 V? $m_p = 1.67 \times 10^{-27}$ kg

2. An evacuated tube uses an accelerating voltage of 40.0 kV to accelerate electrons to hit a copper plate and produce x rays. What is the speed of these electrons?

3. A bare helium nucleus has two positive charges (protons) and a mass of 6.64×10^{-27} kg.
   A. Calculate its kinetic energy in joules at 2.00% of the speed of light. c = 3.00×10^8 m/s.

   B. What is this in electron volts?

   C. What voltage would be needed to obtain this energy?

Answers:

1. A. 5.93×10^6 m/s B. 1.38×10^5 m/s 2. 1.19×10^8 m/s

3. A. 1.20×10^{-13} J B. 7.47×10^5 eV C. 3.74×10^5 V